High resolution study of temporal variations of induction vectors

© *T. Klymkovych[1], I. Rokityansky[2], Yu. Horodysky[1], A. Isac[3], 2010*

[1]Carpathian Branch of Institute of Geophysics, National Academy of Sciences of Ukraine, Lvov, Ukraine
tamara@cb-igph.lviv.ua
[2]Institute of Geophysics, National Academy of Sciences of Ukraine, Kiev, Ukraine
e-mail: rokityansky@gmail.com
[3]Institute of Geophysics of Romanian AS, Bucharest, Romania
margoisac@yahoo.com

The study of temporal variations of induction vectors (**C**) has a long story [Chen, Fung, 1993; Kharin, 1982 and many others]. The companion paper [Rokityansky et al., 2010] (see it for a notations and introductory material) emphasizes on the importance of periodic variations study and presents cases of annual variations. In [Klymkovych et al., 2007; 2009], new high resolution processing program has been developed and applied to magnetic observatory (MO) N. Selyshce data and periodic variations of induction vector parameters have been obtained both for annual and diurnal periods. In this work, high resolution program is applied to the data of MOs Surlari (some 30 km to SE from Vrancha zone and Carpathian electrical conductivity anomaly, Romania) and Dymer (40 km to North from Kiev, NE slope of Ukrainian shield to Dnieper-Donetsk Depression filled by sediments). We used 1 s digital data of three geomagnetic field components and make their averaging over 10, 20, 30, 40 or 60 s to receive input data for consequent processing.

2.5 years: 2008, 2009 and half of 2010 were processed. At all three stations both diurnal and annual variations are clearly seen on some of components. In Dymer the dependence is most clear and magnitude of annual variation attains 0.2 at the longest period 40—60 s at the northern component A, at shorter periods annual variation presents at both components. In Surlary annual variation is seen at all periods except longest one. In Surlari several monthly means behave as outliers that may be related with geodynamic processes in active Vrancha zone. Comparison with the earthquakes appearance is in state of study.

The main body of our talk will be devoted to presentation of numerous graphs received at the tree mentioned observatories and their analysis and discussion.

Diurnal variations are present at all three observatories and they mainly repeat the behavior of annual ones. The day-time external sources differ from night-time ones and both depend on geomagnetic activity. Then diurnal variation of **C** can be (at least partly) prescribed to change of the source parameters. Controlled sources are free of that influence. Dipole soundings in Central Asia and Baltic shield with distance between transmitter and receiver from 10 to 1000 km measured diurnal apparent resistivity variation from 5 to 20 % closely correlated with tides [Zhamaletdinov et al., 2004]. This controlled source experiments prove that noticeable periodic variations of transfer functions can have the tidal nature Stress in the lithosphere active zones can be several orders larger than tidal one. So geodynamic processes shurely can give rise **C** variations.

We review cases of strong lithosphere emission (ULF 0.01—10 Hz) of magnetic field before strong earthquakes Spitak, Loma Prieta, Grevena-Kozani, Biak, Chi-Chi with noticeable enhancement of vertical component, and hence with variation of **C**.

In China dozens 3-component geomagnetic observatories monitor monthly mean induction vector components $|A|$ and $|B|$. Before and after strong EQs, the components noticeable change. For example, northern component |A| of induction vector for period 20min before M6.2EQ 10.01.1998 show half year evolution with maxima 2 month before and during EQ [Zeng et al., 2002]. And what is the most remarkable: the maximum $\Delta|A|$ occur 400 km to ESE from epicenter, over epicenter region no anomaly is observed ("selectivity" effect). So, we can make the conclusion that response function variations can be caused by lithospheric emission or by the change of conductivity or by both.

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References

Chen P. F., Fung P. C. W. Time Changes in Geomagnetic Transfer Functions at Lunping before and after the 1986 Hualian Earthquake [Ms=7.6] // J. Geomag. Geoelectr. — 1993. — № 45. — P. 251—259.

Kharin E. P. Changes in transfer functions with time // Geophys. Surveys. — 1982. — № 4. — P. 455—466.

Klymkovych T. A., Horodyskyy Yu. M., Kuznetsova V. G., Maksymchuk V. Yu. Results of continuous investigations of induction vectors time changes in the seismoactive Transcarpathian trough // Geodynamics. — 2007. — № 1. — P. 41—48 (in Ukrainian).

Klymkovych T. A., Horodyskyy Yu. M., Kuznetsova V. G., Maksymchuk V. Yu. Studies of temporal changes of induction vectors parameters in the Transcarpathian seismically active trough // Geophys. J. — 2009. — **31**, № 6. — P. 147—152 (in Ukrainian).

Rokityansky I., Klymkovich T., Babak V., Savchenko T. Periodic variations of induction vectors // Geophys. J. — 2010. — **32**,№ 4. — P. 139—143.

Zeng X., Liu J-Y., Lin Y., Xu C. The evolution of dynamic images of geomagnetic field and strong earthquake // J. Atmospher. Electr. — 2002. — **22**. — P. 191—205.

Zhamaletdinov A. A., Mitrofanov F. P., Tokarev A. N., Shevtsov A. N. The influence from lunni-solar tidal deformations on results of control source EM monitoring for the seismic activity // Presentation at 32 Intern. Geological Congress (Florence, August 2004). — 2004.